

DRUGS/ MEDICINE INVENTORY WITH RADIO FREQUENCY IDENTIFICATION (RFID) SYSTEM

by

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FINAL PROJECT REPORT

**Submitted to the Electrical & Electronics Engineering Programme
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Electrical & Electronics Engineering)**

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CERTIFICATION OF APPROVAL

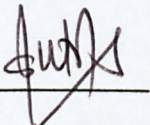
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**A project dissertation submitted to the
Electrical & Electronics Engineering Programme
Universiti Teknologi PETRONAS
in partial fulfilment of the requirement for the
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(Electrical & Electronics Engineering)**

Approved:



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Project Supervisor**

**UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK**

June 2010

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

A handwritten signature in dark ink, appearing to read 'Ili Nadiah', is written over a horizontal line.

Ili Nadiah Binti Mhd Nasir

ABSTRACT

This report basically discusses the progress on research done and basic understanding on the chosen topic, which is **Drugs/ Medicine Inventory with Radio Frequency Identification (RFID) System**. The objective of this project is to enable a break-through revolution in tracking drugs using RFID. Drugs tracking become critical as to ensure proper knowledge management in an organization. Properly tracked drugs provide cost savings in term of reduced effort to locate the drugs, redo or rewrite the drugs information and to prevent lost of valuable drugs. RFID is the right technology of choice to implement drugs tracking. Equipments needed to achieve this project are RFID tags, RFID readers and antennas together with drugs tracking software.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Realization in the business community of the benefits of widespread adoption coupled with advances manufacturing techniques and efficient data-handling methodologies is fostering explosive growth of radio frequency identification (RFID) systems. RFID-enabled applications have grown at tremendous rate with system deployments in a number of industries such as pharmaceuticals, health care, transportation, retail, defense, and logistics. An important aspect of RFID technology is its utilization in a wide spectrum of applications. RFID technology can help a wide range of organizations and individuals realize substantial gains and efficiencies [1].

Existing system components integrate the benefits provided by RFID while maintaining system modularity and efficiency. Radio frequency tags allow objects to become self-describing, communicating their identity to a close at hand RF reader. RFID is replacing bar-code-based identification mechanisms, as communication between a reader and a tag is not limited by the requirement of “line-of-sight” reading and each tag has a unique ID. [1]

RFID technology enables the optimization of multiple business processes through the improvement, the automation or even the elimination of existing processes, and the emergence of new processes called intelligent processes or smart processes, which are automatically triggering actions or events [1].

1.2 Problem Statement

One of the massive problems facing by the pharmaceutical industry is the counterfeit drugs/ medicines that end up on store shelves instead of the real drugs. According to the World Health Organization (Fact sheet No.275, November 2003), an estimated 10% of all pharmaceuticals worldwide are believed to be counterfeit. These figures place the annual earnings from the sales of counterfeit and substandard medicines at over US\$ 32 billion globally. [10]

The problem of managing and tracking drugs or medicine has plagued hospitals and healthcare worldwide. Below are the points that show the operational and economic challenges faced by healthcare industry in managing drugs storage:

- Drugs counterfeiting
- Loss of time due to individual need to search for particular drugs in a medication store room
- Increased inventory cost-reducing the use of file that is currently being used by clinics.
- Increase in labor cost- dedicating individuals to search for particular drugs/ medicine when needed, disgruntled staffs.

1.3 Objective

The objective of the project is to create a new system of drugs/ medicine inventory by using RFID. Individual packages, bottles or containers will be tagged with an RFID label that contains relevant information related to the product, manufacturer, etc. As individual packages are then “assembled” into a case, an association will be made between the individual item and the case, utilizing information from the host system. In order to achieve the objective of this project, some studies need to be done especially on the hardware of this project that is the RFID reader and tags. A research need to be carried to collect technical details and programming of the new system. Furthermore, a detailed understanding on the programming has to be acquired.

1.4 Scope of study

1.4.1 Perform research on current drugs monitoring and control system

In achieving the purpose of developing this system, the author needs to know the current drugs monitoring and control system that have been used by the clinics and pharmacy in Malaysia. From here, author will know about what type of system they have been using either manual or automated, the operation of current system, and applicability of using the tag and reader of RFID need to develop the system.

1.4.2 Perform analysis of RFID tag and reader suitable for the project

In designing the system, the author should know about the current manual set up work used in clinics and pharmacy nowadays. In designing this system, there is a criterion that should be considered. The first one is the range of communication between the tag at the drug containers and the receiver near the drugs storage shelf. Studies need to be carried out to ensure the ability of the tags to successfully communicate with the reader with suitable read range.

1.4.3 Create suitable databases and interface using Xampp and Visual Basic

Suitable databases are highly needed besides the communication technologies used. This database needs to be user friendly and maximizing its usage. With this, definitely it can ease the medical clinic office staff to adapt with the new system. So, by using Xampp as its database software, MySQL connector-net 5.0.9 as connector between the database and the interface and Visual Basic 2008 as the interface, this new system can be a user friendly system and easy to get used with.

CHAPTER 2

LITERATURE REVIEW

2.1 Theory

Radio Frequency is a term that refers to alternating current (AC) having characteristics such that, if the current is input to an antenna, an electromagnetic field is generated suitable for wireless broadcasting and communications [4].

The radio frequency spectrum is divided into several ranges or bands. With the exception of the lowest-frequency segment, each band represents an increase of frequency corresponding to an order of magnitude (power of 10). Table 1 depicts the eight bands in radio frequency spectrum, showing frequency and bandwidth ranges [5].

Table 1: Eight Bands in Radio Frequency Spectrum.

Designation	Abbreviation	Frequencies	Free-space wavelength
Very Low Frequency	VLF	9kHz-30kHz	10km-100km
Low Frequency	LF	30kHz-300kHz	1km-10km
Medium Frequency	MF	300kHz-3MHz	100m-1km
High Frequency	HF	3MHz-30MHz	10m-100m
Very High Frequency	VHF	30MHz-300MHz	1m-10m
Ultra High Frequency	UHF	300MHz-3GHz	10cm-100cm
Super High Frequency	SHF	3GHz-30GHz	1cm-10cm
Extremely High Frequency	EHF	30GHz-300GHz	1mm-10mm

Radio Frequency Identification (RFID) is one of radio frequency applications. It is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification using radio waves. Some tags can be read from several meters away and beyond the line of sight (LOS) of the reader [5].

All RFID systems are comprised of three main components:

- RFID tag (transponder) which is located on the object to be identified and is the data carrier in the RFID system.
- RFID reader (transceiver) which may be able to both read data from and write data to transponder.
- Databases and interface which utilizes the data obtained from the transceiver in some useful manner.

Figure 1 shows the basic components of an RFID system [2].

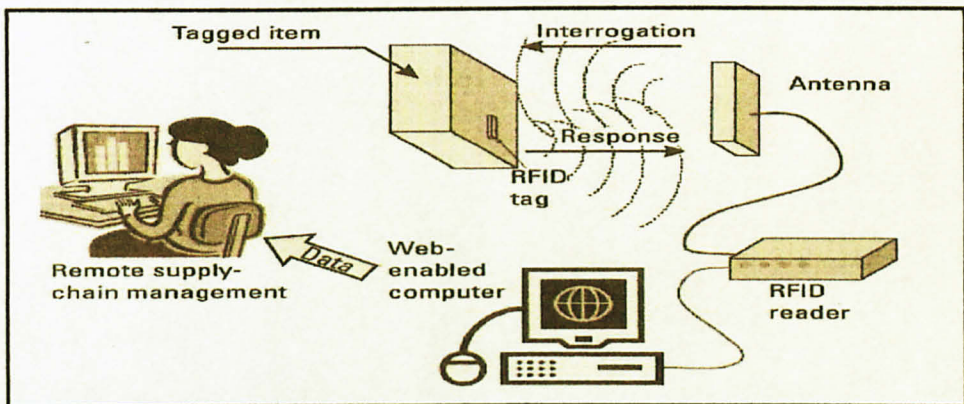


Figure 1: Basic Components of an RFID System.

RFID systems are also distinguished by their frequency ranges.

- Low frequency or LF (30 KHz to 500 KHz) systems have short reading ranges and lower system costs. They are most commonly used in security access, asset tracking and animal identification.
- High frequency or HF (850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz) systems, offering long read ranges (greater than 90 feet) and high reading speeds, are used for such applications as railroad car tracking and automated toll collection. However, the higher performance of high frequency RFID systems incurs higher system costs.
- Ultra high frequency or UHF.

Figure 2 shows the block diagram of a basic RFID circuit system [8].

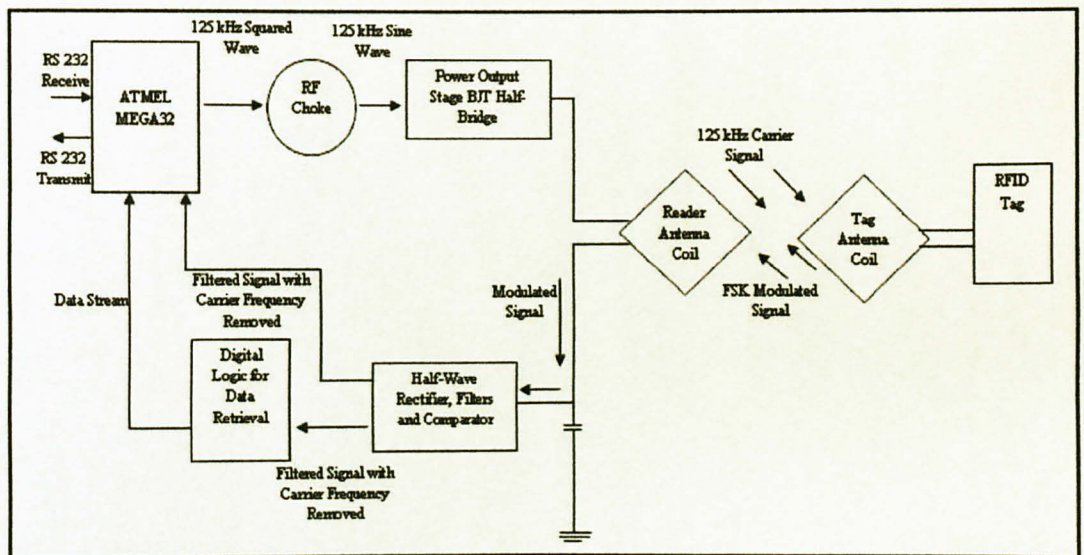


Figure 2: Block Diagram of RFID Circuit System.

2.1.1 Operating Principles of RFID [11]

There is a variety of operating principles for RFID systems.

2.1.1.1 Inductive Coupling

An inductively coupled transponder comprises of an electronic data carrying device, usually a single microchip and a large area coil that functions as an antenna.

Inductively coupled transponders are almost always operated passively. This means that all the energy needed for the operation of the microchip has to be provided by the reader. For this purpose, the reader's antenna coil generates a strong, high frequency electro-magnetic field, which penetrates the cross -section of the coil area and the area around the coil. Because the wavelength of the frequency range used (< 135 kHz: 2400 m, 13.56 MHz: 22.1 m) is several times greater than the distance between the reader's antenna and the transponder, the electro-magnetic field may be treated as a simple magnetic alternating field with regard to the distance between transponder and antenna.

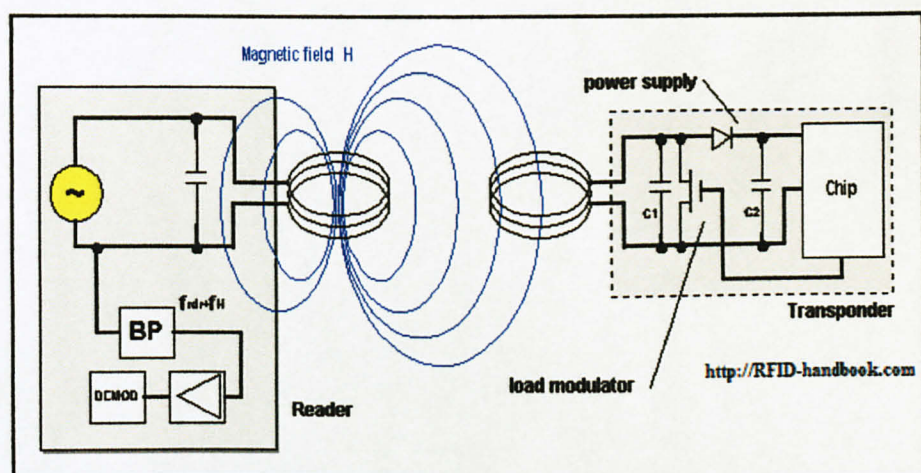


Figure 3: Operation Principle of Inductive Coupling

As described above, inductively coupled systems are based upon a *transformer-type coupling* between the primary coil in the reader and the secondary coil in the

2.1.1.2 Backscatter Coupling

We know from the field of RADAR technology that electromagnetic waves are reflected by objects with dimensions greater than around half the wavelength of the wave. The efficiency with which an object reflects electromagnetic waves is described by its reflection cross-section. Objects that are in resonance with the front wave that hits them, as is the case for antenna at the appropriate frequency for example, have a particularly large reflection cross-section.

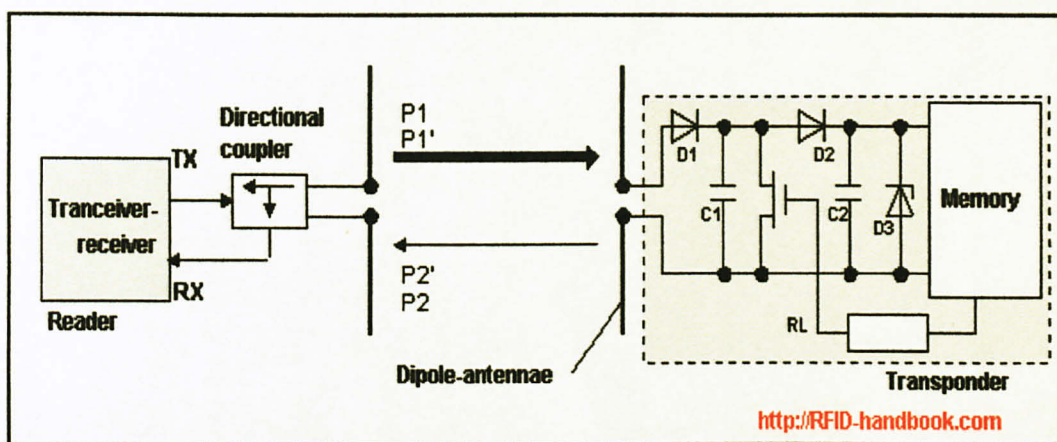


Figure 5: Operation Principle of a Backscatter Transponder

Power $P1$ is emitted from the reader's antenna, a small proportion of which (free space attenuation) reaches the transponder's antenna. The power $P1'$ is supplied to the antenna connections as HF voltage and after rectification by the diodes $D1$ and $D2$ this can be used as turn on voltage for the deactivation or activation of the power saving "power-down" mode. The diodes used here are low barrier Schottky diodes, which have a particularly low threshold voltage. The voltage obtained may also be sufficient to serve as a power supply for short ranges.

2.1.2 Operating Frequencies

Frequency refers to the size of the radio waves used to communicate between the RFID systems components. It is generally safe to assume that a higher frequency equates to a faster data transfer rate and longer read ranges, but also more sensitivity to environmental factors such as liquid and metal that can interfere with radio waves. RFID systems currently operate in the Low Frequency (LF), High Frequency (HF) and Ultrahigh Frequency (UHF) bands. Each frequency has advantages and disadvantages relative to its capabilities. Generally a lower frequency means a lower read range and slower data read rate, but increased capabilities for reading near or on metal or liquid surfaces. No single frequency is ideal for all applications, even within a single industry. Just as separate bar code symbologies are used at different levels of consumer goods packaging, from U.P.C./EAN symbols at the item level to Code 128 and two-dimensional symbologies on cases and pallets, RFID tags of different frequencies and functionality will be used together within overall supply chain operations. [10] Table 2 shows a quick cross-section of the types of RFID technologies out there, their uses and their typical read ranges [3].

Table 2: RFID Frequencies, Uses and Typical Range.

Frequency	Use	Pros and Cons	Range
125 kHz- 148 kHz Low Frequency (LF)			
Type: Passive	Animal Tracking, access control and Original Equipment Manufacturer (OEM) Applications	Signal negotiates liquids and metals fairly well. Higher tag cost due to long length solid copper antennas	½ to 4" is typical. 6" to 12" or maybe possible with specialized equipment.
13.56 MHz High Frequency (HF)			
Type: Passive	Anti-theft, document management, access control and OEM Applications	Antennas can be printed on substrate/labels, lowering tag costs. Serious interference from metals.	Can range from inches to several feet depending on reader hardware and tag type.
433 MHz (and 2.5 Ghz) Ultra High Frequency (UHF)			
Type: Active	Highway toll payment systems, vehicle management, asset tracking, etc.	Very long range. Very high tag cost. Uses battery, so tags have finite lifespan (typically 5 years)	Typically around 30 feet, but can range up to hundreds of feet.

2.2 Reader/ Antennas

The reader, also known as an interrogator, is a device that provides network connectivity between tag data and interface. The reader communicates with the RFID tags within its field of operation, performing any number of operations including simple continuous inventorying, filtering (searching for tags that meet certain criteria), writing to selected tags, etc.

The reader uses its antenna to send digital information encoded in a modulated waveform as well as the tone that the tag uses to power itself. A receiver circuit on the tag is able to detect the modulated field, decode the information, and use its own antenna to send (backscatter) a response. Readers may be fixed (dock door or shelf installations), mobile (installed on a forklift or hand-held), or in the form of a module contained within a printer/encoder [7].

An antenna converts electrical current into electromagnetic waves that are then radiated into space in a particular pattern at a given level of intensity. The parameters of greatest interest to the tag are polarization (or the reader antenna wave's electric field vector, orientation, and direction) and the power level of the transmission.

A linearly polarized antenna radiates entirely in one plane in the direction of signal propagation, while with a circularly polarized antenna, the plane of polarization rotates in a circular fashion (effectively a corkscrew when considered in time), making a complete revolution during one period of the wave. Figure 6 below shows the basic configuration of reader and tag antenna in any RFID application [7].

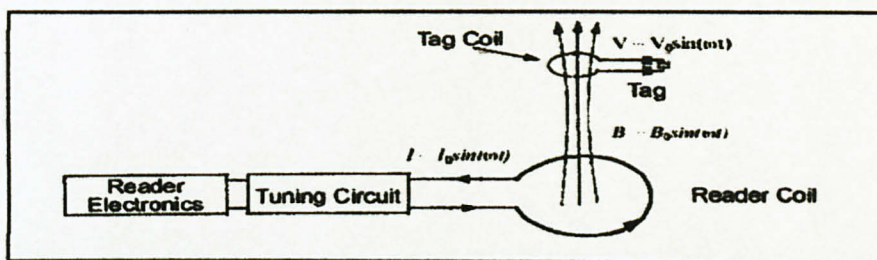


Figure 6: Basic Configuration of Reader and Tag Antenna in RFID Application.

2.3 Tags

An RFID tag generally comprises an integrated circuit (IC) that has been mounted on a flexible PET (PolyEthyleneTherephthalate) or paper substrate, which has been preprinted with conductive ink (or assembled with an etched, stamped, or vapor-deposited antenna pattern), according to the particular antenna design. The resulting inlay assembly is then converted or sandwiched between a printed label and its adhesive backing, yielding a smart label. The label can then be programmed with a unique tracking identifier called an electronic product code (EPC) and attached to an item, case, or pallet [7]. Below are some of the examples of RFID tags:

- i. 13.56MHz High Frequency (HF) Rectangle Paper RFID Tag

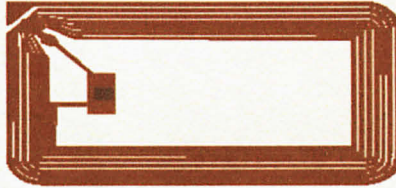


Figure 7: High Frequency Rectangle Paper RFID Tag.

- ii. 13.56 MHz High Frequency (HF) Round Paper RFID Tag

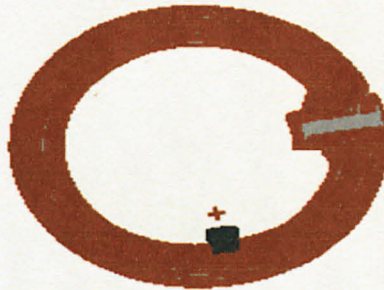


Figure 8: High Frequency Round Paper RFID Tag.

iii. 13.56 MHz High Frequency (HF) Square Paper RFID Tag

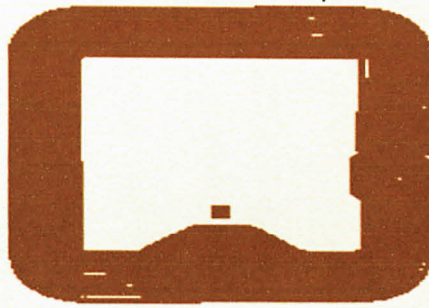


Figure 9: High Frequency Square Paper RFID Tag.

2.3.1 Active RFID Tags

Active RFID is a long range communication approach that has a reading distance between 50 m (150 feet) to 100 m (300 feet). Tags are powered by an internal battery and are typically read/write, where tag data can be rewritten and/or modified. An active tag's memory size varies according to application requirements; some systems operate with up to 1MB of memory. In a typical read/write RFID work-in-process system, a tag might give a machine a set of instructions, and the machine would then report its performance to the tag [8]. This encoded data would then become part of the tagged part's history. The battery supplied power of an active tag generally gives it a longer read range. The trade off is greater size, greater cost, and a limited operational life (which may yield a maximum of 10 years, depending upon operating temperatures and battery type).

2.3.2 Passive RFID tags

Tags operate without a separate external power source and obtain operating power generated from the reader. Passive tags are consequently much lighter than active tags, less expensive, and offer a virtually unlimited operational lifetime. The trade off is that they have shorter read ranges, typically a few feet at most than active tags and require a higher-powered reader. Read-only tags are typically passive and are programmed with a unique set of data (usually 32 to 128 bits) that cannot be modified. Read-only tags most often operate as a license plate into a database, in the same way as linear barcodes reference a database containing modifiable product-specific information.

2.3.3 Differences between active and passive RFID tags [12]

2.3.3.1 Differences in the Technical Characteristics

Passive tags contain an integrated chip or circuit to absorb radio frequency waves from reader's signals and to send and receive data, low frequency or high frequency antennae and a plastic or mylar substrate which holds the pieces of the tag together. Since there is no battery, the power is supplied by the reader which draws the radio waves through the antennae forming a magnetic field. This allows the supply of the power to the tag which is restricted to the field of the reader. On the other hand, an active tag which is substantially larger than a passive tag features two additional components, an on board power supply and on board electronics. The power supply to an active tag is through battery although some may be solar power driven. The on board electronics consisting of sensors, microprocessors and I/O units are powered by the on board power which enables it to transmit the data to the reader on its own. With a continuous availability of tag power, the required signal strength from the reader to the tag is lower than what is

required for a passive RFID tag. Also, the available signal strength is higher from a tag to a reader in an active tag.

2.3.3.2 Communication Range

Since passive RFID tags are constrained by the need for strong signals to power the tag and the small amount of power to respond to the reader, the communication range of a passive tag is limited to 3 meters or less. Active tags do not have the constraint of power and can thus transmit to as far as 100 meters or more.

2.3.3.3 Data Storage

Although both these varieties of RFID tags can dynamically store data, active RFID tags have large read and write data storage almost 128 kilobytes and sophisticated data search and access capabilities. In a passive RFID, the data storage is less than 128 bytes with no search capabilities or data manipulation features.

2.3.3.4 Sensor Capabilities

While active RFID tags are able to continuously monitor and record sensor input, passive tags are able to monitor and record sensor input only when the tag is powered by the reader.

2.3.3.5 Multi Tag Collection

Since the communication range of a passive RFID tag is limited to 3 meters or less, it can collect 100 or so tags, at the range from only a single reader. In contrast, an active tag can collect more than 100 tags from a seven acre region using a single reader.

2.4 Advantages

The significant advantage of all types of RFID systems is the noncontact, non-line-of-sight nature of technology. Tags can be read through a variety of substances such as snow, fog, ice, paint, crusted grime, and other visually and environmentally challenging conditions, where bar codes or other optically read technologies would be useless. RFID tags can also be read in challenging circumstances at remarkable speeds, in most cases responding in less than 100 milliseconds. The read/write capability of an active RFID system is also a significant advantage in interactive applications such as work-in-process or maintenance tracking. Though it is a costlier technology (compared with bar code), RFID has become indispensable for a wide range of automated data collection and identification applications that would not be possible otherwise [9].

Developments in RFID technology continue to yield larger memory capacities, wider reading ranges, and faster processing. It is highly unlikely that the technology will ultimately replace bar code – even with the inevitable reduction in raw materials coupled with economies of scale, the integrated circuit in an RF tag will never be cost-effective as a bar code label. However, RFID will continue to grow its established niches where bar code or other optical technologies are not effective.

2.5 Current Tagging Systems of RFID Applications

2.5.1 Automated Inventory Tracking

InvenTrack is a RFID (Radio Frequency Identification) based inventory management software. Tracking inventory is based on RFID Stock Card. Information related to inventory on-shelf will be updated whenever there is any adding or subtracting of items on the shelf. Data will be updated by InvenTrack software application and consolidation of information can be done via productivity software such as MS Excel, MS Access and many other database systems. This InvenTrack has already been applied only at some warehouses in Malaysia for stock checking and stock inventory purpose.



Figure 10: InvenTrack3000 Package

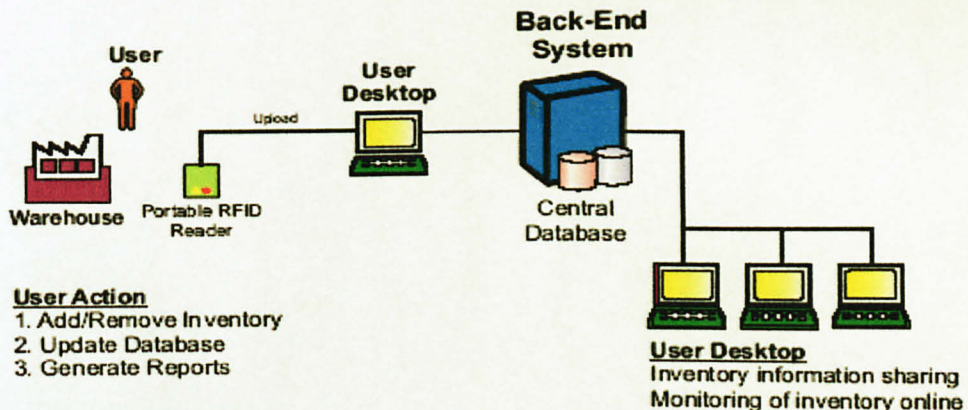


Figure 11: InvenTrack3000 System

For a variety of reasons, adoption of RFID technology by the healthcare industry has been sluggish because payback is less immediately visible than what most companies prefer. Although costs are decreasing, many companies are reluctant to invest in a technology not yet widely adopted. Maximizing RFID benefits also requires modifying existing business processes, a daunting task that usually entails changes in technology investment strategies. Without clear RFID standards and data ownership policies, investment in RFID has been a difficult proposition. [13]

Therefore, by introducing this drugs/ medicines inventory by using RFID will simply encounter major problem in healthcare field such as drugs counterfeiting. This new system which consists of RFID reader, passive tags, Graphical User Interface (GUI) and databases will absolutely become a user friendly, easy to use and cheap based on its features.

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification

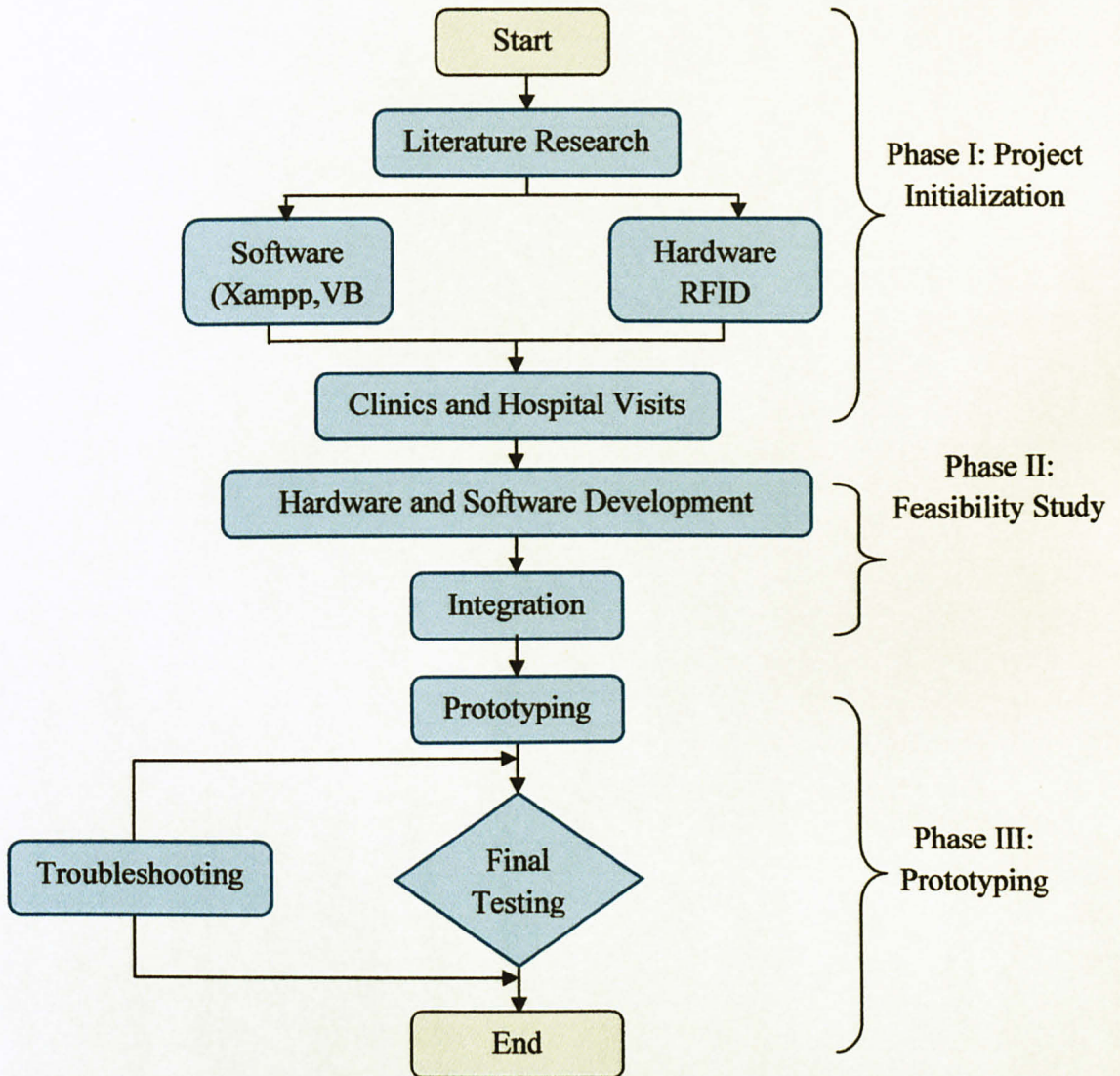


Figure 12: Project Flowchart.

3.1.1 Phase one (Project Initialization)

Phase I is the early stage of the project development. Firm planning and understanding of the project is a must so that the project will be completed successfully. The understanding of the project is including the research on the technology that wants to be used that is RFID.

Several clinics around Tronoh such as Klinik Che Wan, Poliklinik Seri Iskandar, Poliklinik Permai and Poliklinik Azhar and Malaysia's internationally-accredited private healthcare facility, Prince Court Medical Centre pharmacy were visited to get more information about the current drugs inventory system they are using. From the visit, several findings have been discovered. Most of the clinics were using manual inventory system where they need to manually update their inventory system regularly. Besides, most of the clinics inventory systems for drugs they have been adopted currently were not fully secured.

Furthermore, the visit has given more opportunity to meet personally with the doctors for professional opinion about the project and lots of advice given to see the project succeeded. This eventually will benefit the author as the successor for the project.

3.1.2 Phase two (Feasibility Study)

Phase II is where the designing the layout and the process of the system will be done. Choosing the right hardware that has to be used and development of the software and the database must be ready within this phase. Early research has been made for the hardware and software needed for this project. The hardware needed are RFID Active Tag and RFID reader. The specification and the price tag of the hardware have also been considered to meet the requirement of the project.

3.1.3 Phase Three (Prototyping)

Last but not least is phase III; it is the beginning of the fabrication for the prototype. The integration will be focusing on the interfacing between devices, hardware and system of the project. In final testing stage, the project should be tested for its completion after the prototype finished with the combining of all of the hardware and the software application.

3.2 Block Diagram of Overall System

Figure 13 shows the simple block diagram of overall system of this project.

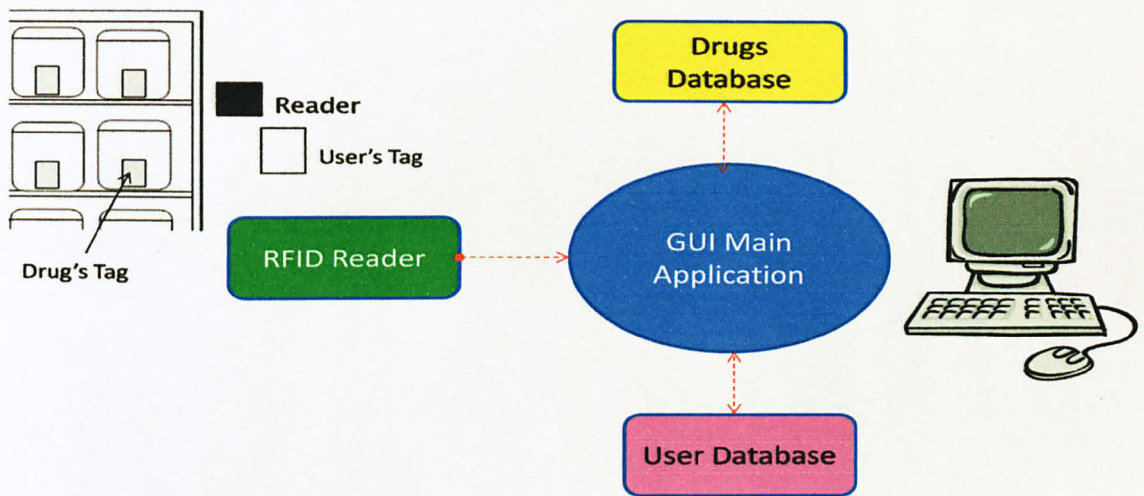


Figure 13: Block Diagram of Overall System.

3.3 Project Overview

Figure 14 shows the overview of the system.

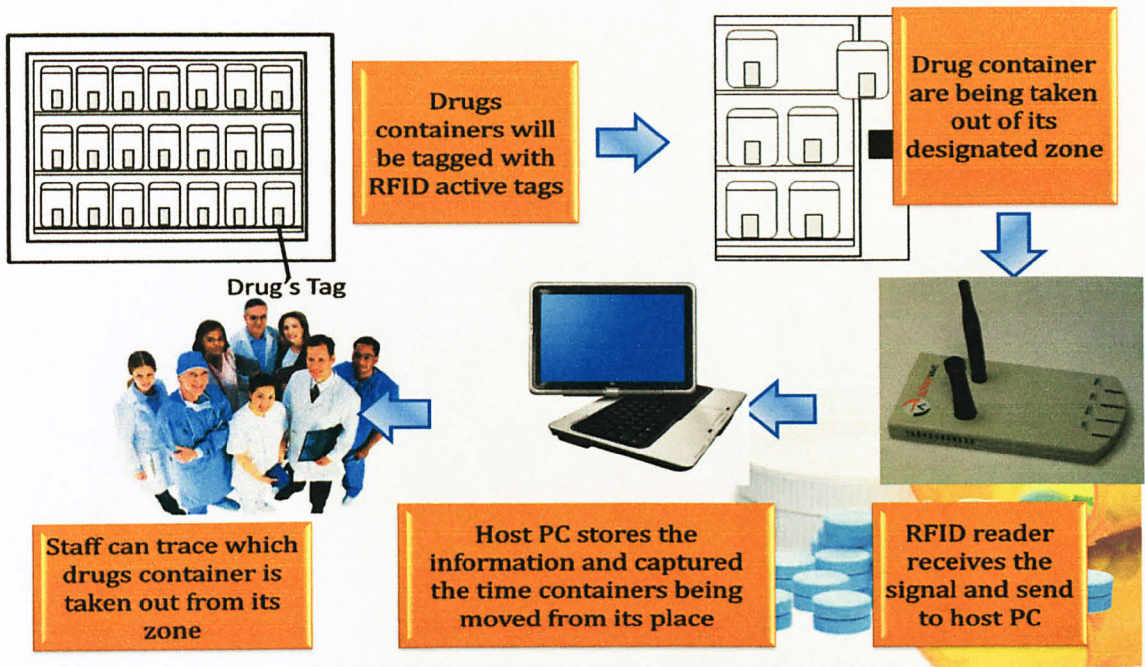


Figure 14: Project Overview

To make the system works, the right sequence of process must be followed. This is to ensure that the system to works perfectly:

1. Every new registered drugs/ medicine containers will be tagged with RFID active tag which will be stored on the shelf in drugs warehouse.
2. The attached tags are monitored by a network of sensors wired into the main drugs warehouse personal host computer.
3. The host computer can only be access by registered users with unique password.
4. If one the registered tag is out of range, an alert window will appear in the system to alert the staff.
5. The time and date will also be captured if the tagged drug container is taken out and being placed back on its shelf.

3.4 Applied Tools and Technologies

3.4.1 RFID Tags

For this project, active RFID will be used as the tag. The tags will be tagged on each drugs/ medicines container. Below are the specifications for active tags.

Table 3: Active Tag Specifications

User Memory	0 – 256 Kbits	
Multi-Tag Read Capability	Yes	
Transmit Frequency	916 MHz, 927 MHz, or 868 MHz	
Receive Frequency	433 MHz	
Read Range	Receive	85m (280 feet)*
	Transmit	152m (500 feet)*
Power	3V Lithium-ion watch battery	
Battery Life	1 – 3 years depending on use (tag has low battery detection)	
Weight	23 grams (0.8 oz)	
Case Material	ABS (Acrylonitrile Butadiene Styrene)	
Temperature	Operating	-35C to +50C (-31F to +122F)
	Storage	-40C to +85C (-40F to +185F)
Options	Memory	0 – 256Kbit memory sizes available in 2x increments

3.4.2 Advantages of using RFID Active Tags

Although active RFID need a power source compared to passive RFID tags, it can store much bigger data and information. It also can broadcast response signal to the reader. This active tag is typically more reliable as there are only fewer errors than passive tags due to the ability for it to conduct 'session' with the reader. The Active Tag used for this project has characteristics as below;

- i. Long communication range
- ii. Having the capability of initiating communications (e.g. communicate with the reader each time patient having more than 39°C)
- iii. Having the capability to perform independent monitoring and control (e.g. monitor temperature of the patient each 4 hours)
- iv. Need battery power to function, which limit the lifetime and affect the cost for long-term maintenance.
- v. The tag can stand a harsh environment
- vi. Capable of perform independent monitoring and control

3.4.3 RFID Reader

A RFID reader would be connected to a computer. When the computer file for the drugs is being set up in the computer, this RFID reader would automatically read the unique RFID circuit number and software would associate this number to the file known by description being entered into the computer.

RFID circuit readers are the size of smoke detectors would be mounted near the shelf and one at the entrance of drugs storage room for user identification. Each reader has a unique ID number and that software would know each reader location. When a drug is taken out from the shelf, the software would capture this and present a path of the shelf the drugs go through. The readers can be hard wired into a network or transmit their data back to a central server or via wireless RF communications. For this

project, the reader will be hardwired into the system by using RJ-45 straight through cable.

3.4.4 Database and User Interfaces

For this project, the software used to create the drugs/ medicines database is the Xampp software. The main purpose of creating the database is to record access to drugs storage. The database has security levels appropriate to the needs of the clinic/ pharmacy.

First, the database is created and the purpose is to stored details about the users and the drugs information. Users' details such as full name, identification number and password will be created. After that, the drugs' details such as drugs name, drugs description and location will be created.

After the database has been created, user interface is formed refer to the database created. For this project, the software used to create the interface is the Visual Basic 2008 (VB) software. The login interface is first produced to let the users an easy access to the database. User's identification number and password must match correctly and this data is retrieved from the database. Once the user has entered the correct identification number and password, the user will be directed to the homepage.

User history can be checked under this homepage. Data is retrieved from the database, as well as from the hardware.

3.5 Architectural Overview

Architectural overview is to explain about the concept of this project. It consists of the drugs layout and some detailed explanations of RFID tagging systems for drugs.

3.5.1 Drugs Shelf Layout

Figure 15 below show the drugs layout, where each drug is tagged with an active RFID tag and a reader is placed at the right-hand side of the shelf.

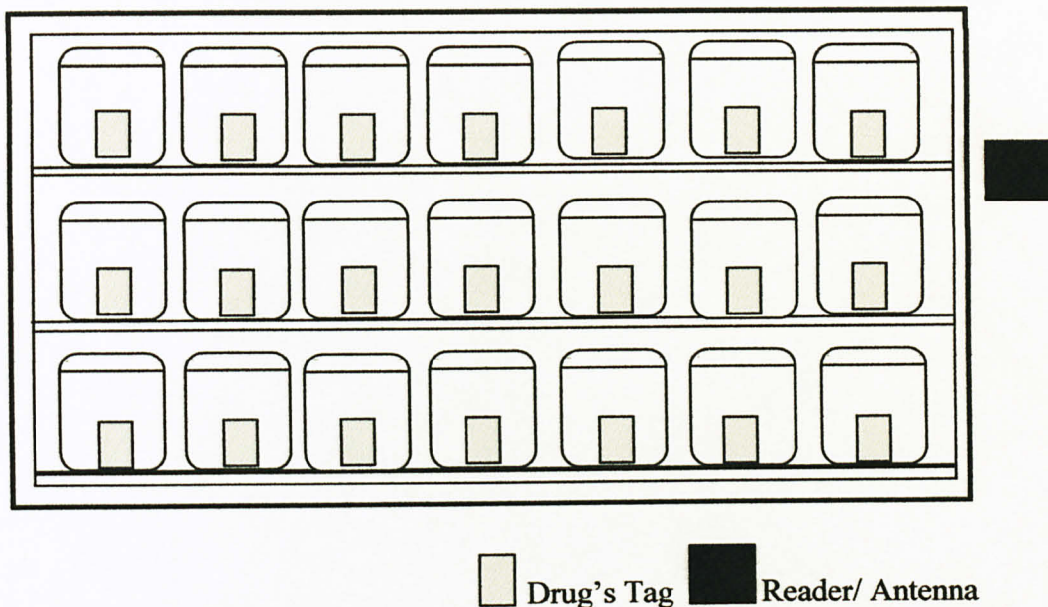


Figure 15: Drugs Shelf Layout.

3.5.2 Access to drugs

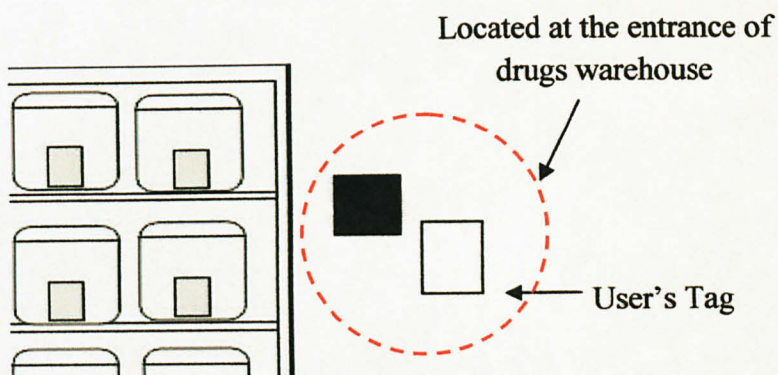


Figure 16: Access to Drugs Warehouse.

User's tag will be activated once user approaches the entrance to the drugs warehouse as shown in Figure 16. User's details together with captured time will be updated on the database. If any drug is being taken out, drugs details will be recorded in database created before.

3.6 Hardware testing

3.6.1 RFID tag and reader configuration

Active tag RFID have been chosen to be used in this project since it has longest communication range and can conclude almost around the area of the lecture hall. As for the project, I have been using the product from ActiveWAVE RFID. There are several reasons of choosing the ActiveWAVE RFID tag and reader for this project. Below are some of the reasons:

Advantages over other RFID Active Tags:

- **Longer Life** - ActiveWave uses the latest technology to achieve reliability and life that rivals other active tags.
- **Lower Cost** - ActiveWave RFID tags uses the latest technology and integration to provide you with a very cost effective tag.
- **Smaller Size** - ActiveWave RFID tags are smaller than Active tags based on older technology.



Figure 17: ActiveWave Reader



Figure 18: ActiveWave Tags

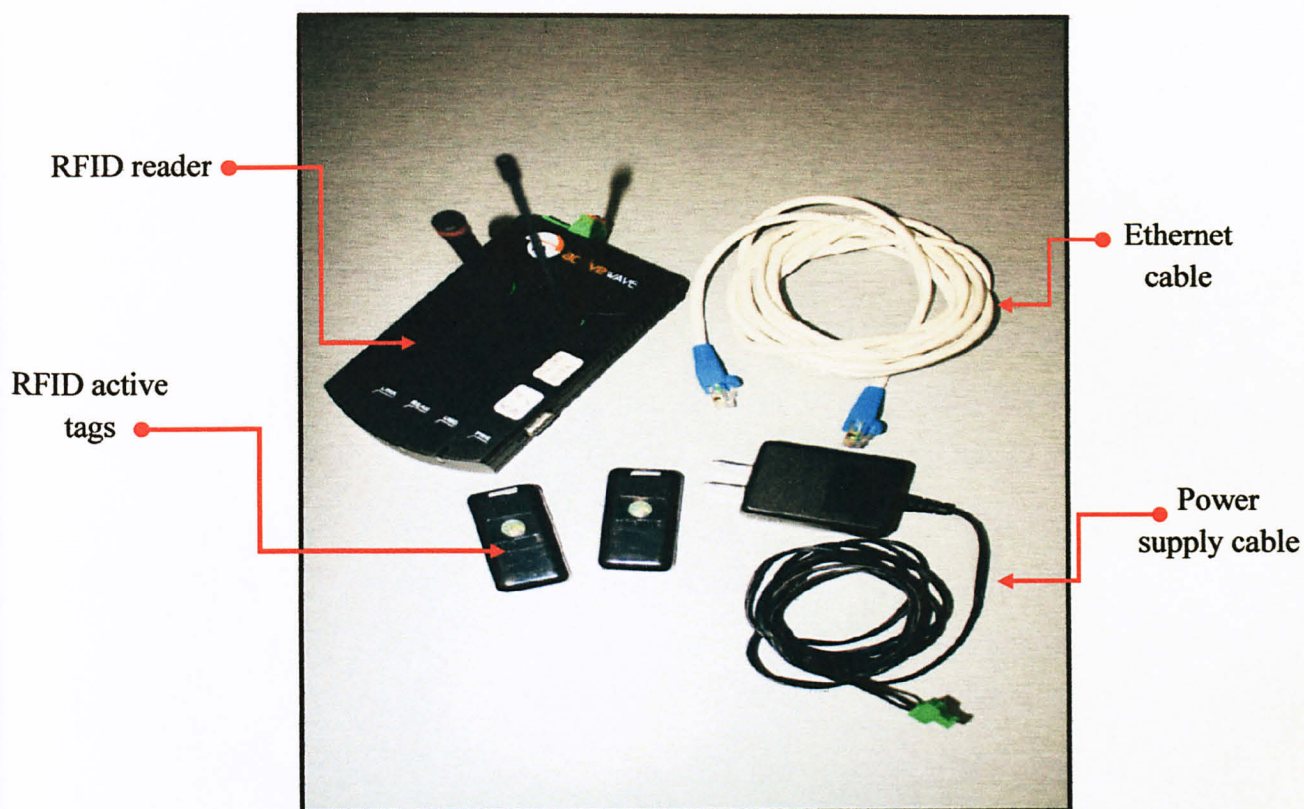


Figure 19: Components of ActiveWave RFID

Table 4: Function of Each ActiveWave RFID Components

Component	Function
Reader	Receive signal send from the active tags.
Tags	Send signal to reader.
Ethernet Cable	Communication between the reader and host computer.
Power Supply Cable	Supply power to power up the ActiveWave RFID reader.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Results and Discussions

4.1.1 Development of User Interface using Visual Basic 2008 (VB)

Interfaces for the system have been developed using Visual Basic 2008 (VB). Below shown in Figure 20 is the RFID Query Server interface. Before user wants to enter the main menu of the system, user needs to run this window first. The purpose of this window is to connect the RFID reader with the system developed. Besides, this window will query all the registered tags and the time and date captured when the drugs were being taken out from the shelf will be displayed in this window.

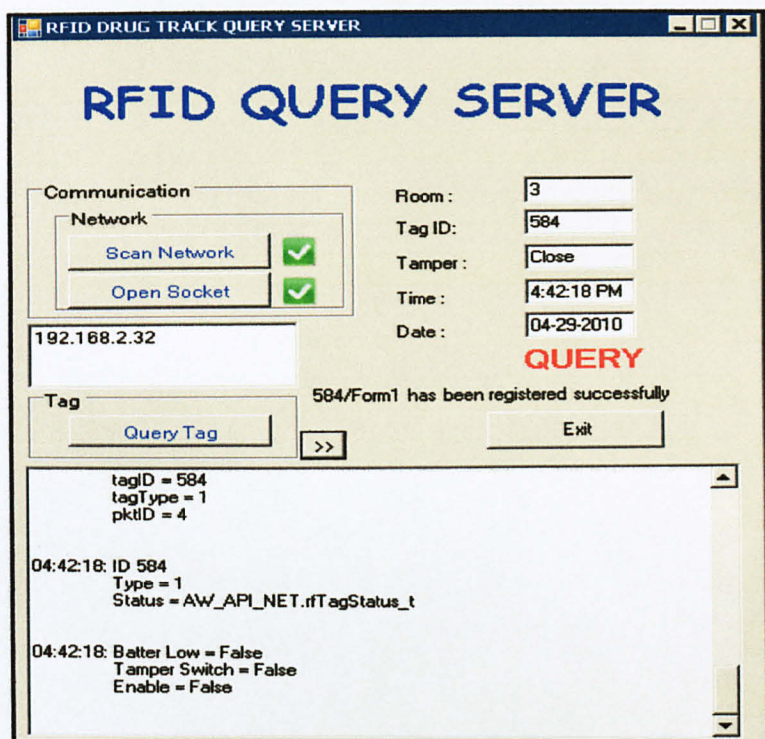


Figure 20: RFID Query Server Window

Below is the User Log In interface to enter the main menu of the system. Once the user enters ID number and password correctly as shown in Figure 21, user will be directed to the main page of the Drugs Inventory. If user enters the information wrongly, a prompt window will appear as shown in Figure 22.

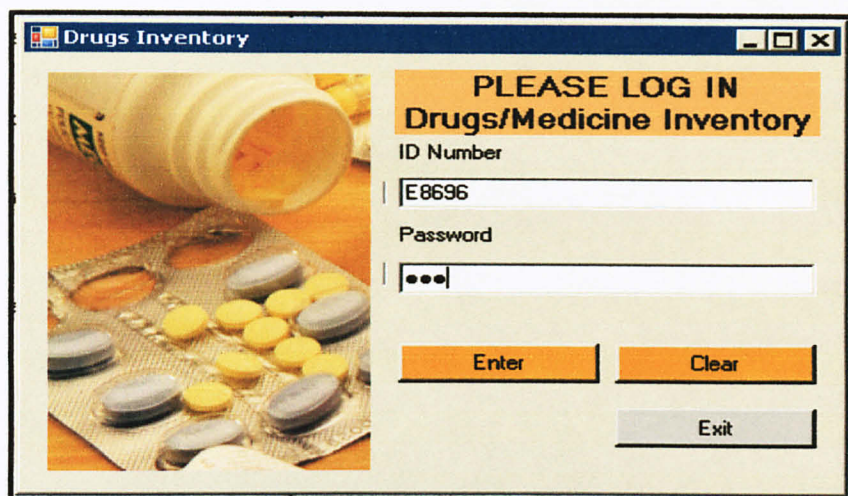


Figure 21: User Log in Interface

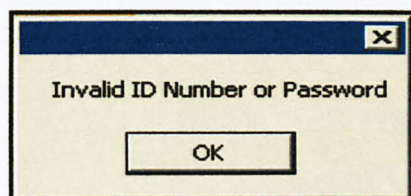


Figure 22: Prompt Window When Name, ID Number and Password Are Entered Wrongly.

Once the login is successful, user will be directed to the main page of Drugs Inventory as shown in Figure 23. In this window, the user's name will appear as the operator of the system. From this, we can trace who is the last person operates and used the system. Besides, from this main menu, user can track when a drug is being taken out from the shelf or the drug is out of designated zone. The tag ID and the name of the drug will appear at the alert box if it is taken out of the shelf or out of the


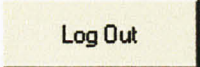





zone. There are many buttons that links the main page to other sub-page. Below is the table for functions of each button.



Figure 23: User’s Main Window.

Table 5: The Functions of Buttons on the RFID Query Server and Main Menu

No.	Button	Functions
1.	<div>Scan Network</div>	<ul style="list-style-type: none"> • This button will scan the network • Any active network (IP Address) will be list out in the IP List Box next to the button.
2.	<div>Open Socket</div>	<ul style="list-style-type: none"> • This button is used to connect with the RFID IP Address. • Once it is clicked, the system is already connected to RFID reader.

3.		<ul style="list-style-type: none"> • This button is to allow user to query a tag. • Tags that are enabled or disabled respond to a query command. The query response includes much information about the tag.
4.		<ul style="list-style-type: none"> • This button is the log out button when user wants to exit from the system.
5.		<ul style="list-style-type: none"> • This starts button will activate the connected RFID with the system. • Once it is clicked, the RFID reader will starts to read every active tag assigned to the system.
6.		<ul style="list-style-type: none"> • The purpose of this button is to add new personnel who want to be the operator of the system. • Information needed to be filled in is the user name, ID number and password. • All the information inserted will be saved in the database for staff record.
7.		<ul style="list-style-type: none"> • This button is clicked when there is new drug to be added in the system. • Several important information are needed in order to add new drugs to the system such as drug's name, description, etc. • All the data inserted will be updated in the database.
8.		<ul style="list-style-type: none"> • The purpose of this button is to view every drug that has been registered into the system.
9.		<ul style="list-style-type: none"> • This button is to view all the registered users.

Start

1. When button is clicked, the 'on' indicator will appear in green color.



Figure 24: The system 'on' status appear in User's Main Window

Add Staff

2. When button is clicked, the window where user need to fill the information to register new user.

Add New Personnel

Drugs/ Medicine Inventory
RFID Tagging System for Drugs

ID : E8696

Full Name : Ili Nadiyah

Password : ●●●

Confirm Close

Figure 25: Add New Personnel Window

Add Drugs

3. When **Add Drugs** is clicked, another window will appear for user to fill in the information for new registered drug.



Add New Drugs

Drugs/ Medicine Inventory
RFID Tagging System for Drugs

Drug Name: Nitrostat

Description: Stabilized sublingual compressed nitroglycerin tabl

Tag ID: 201

Manufacturer: Wyeth

Acquisition Date: 2010-09-19 2/16:34:58

Expiry Date: 2012-12-12

Manufacturer's Contact: 012-98374631

Room: 3

Submit Clear Close

Figure 26: Add New Drugs Window

Once the user has fill in the required information, user need to click the submit button to save the information in the database. If all the blank field has been filled in, a pop-out window will appear to verify user that the drug were successfully being registered after the submit button were clicked.



Figure 27: Prompt window when drug is successfully registered

Drugs List

4. When is clicked, all the registered drugs and its information will appear in this window.

Drugs List						
No	Description	Drug Name	Tag ID	Room	Expiry Date	Contact No.
1	Multi-Vitamin	Pharmaton	202	3	1/1/2011 12:00:00 AM	03-92837462
2	Stabilized subli...	Nitrostat	201	3	12/12/2012 12:00:00 AM	012-98374631
3	strong antibiotic	Penicillin VK	203	3	12/3/2010 10:21:32 AM	607-5324098
4	Stabilized subli...	Nitrostat	201	3	12/12/2012 12:00:00 AM	012-98374631
5	for low blood p...	Vanzuela Viscos	584	3	9/18/2014 12:00:00 AM	607-9827476
6	sakit perut	Minyak Yuyi	1001	3	9/11/2010 12:00:00 AM	013-9283873489
7	light headache	Paracetamol	1000	3	11/3/2011 12:00:00 AM	013-4711143

Figure 28: Drug List Window

Satff List

5. When is clicked, all the registered users will appear in this window.

Personnel List		
No	ID	Name
1	1	sajeta
2	E8106	Muhammad Afiq
3	E8696	Ili Nadiyah
4	E8667	Anith SAfura

Figure 29: Personnel List Window

4.1.2 System Database

The database has been developed by using Xampp software. MySQL connector-net 5.0.9 as a connector between databases and interface. For this project, it consists of four tables, which are users table, drugs table, alarm table and readers table. Below shown in Figure 30 is the system database which is name by drugtrek_db.

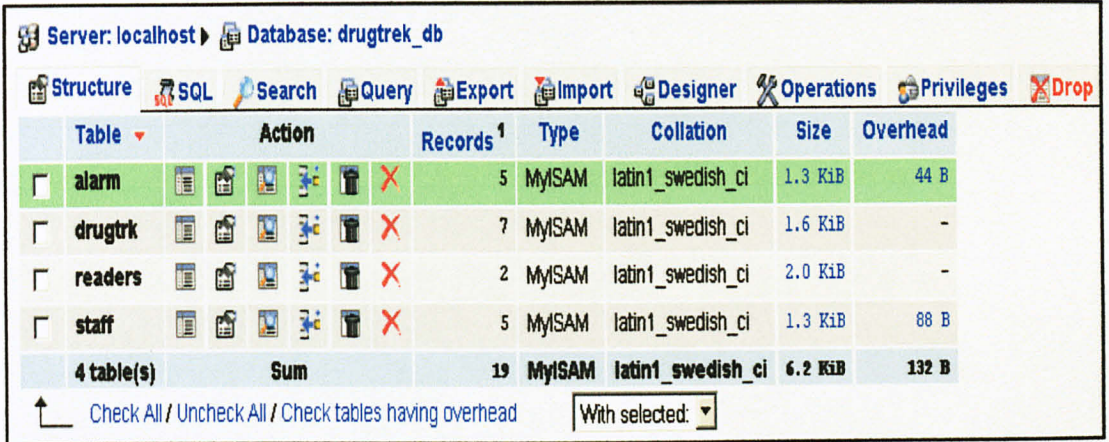


Table	Action	Records ¹	Type	Collation	Size	Overhead
alarm		5	MyISAM	latin1_swedish_ci	1.3 KiB	44 B
drugtrk		7	MyISAM	latin1_swedish_ci	1.6 KiB	-
readers		2	MyISAM	latin1_swedish_ci	2.0 KiB	-
staff		5	MyISAM	latin1_swedish_ci	1.3 KiB	88 B
4 table(s)	Sum	19	MyISAM	latin1_swedish_ci	6.2 KiB	132 B

Figure 30: Overall system database

4.1.2.1 Users

In order to build users database, a table must be created. Following the creation of the users table, it is required to insert the columns that will make up the user table. By using Table 6 as reference, the necessary columns will be inserted with the particular data that will make up the user table for the user interface as shown in Figure 31.

Table 6: Table summary for user table

Field	Type	Length/ Values	Extra	Key
Name	varchar	10		
Staff ID	varchar	5		Primary key
Password	varchar	10		

Server: localhost Database: drugtrek_db Table: staff "Contain informations for officer"

Browse
 Structure
 SQL
 Search
 Insert
 Export
 Import
 Operations
 Empty
 Drop

	Field	Type	Collation	Attributes	Null	Default	Extra	Action
<input type="checkbox"/>	id	varchar(10)	latin1_swedish_ci		No	None		
<input type="checkbox"/>	name	varchar(50)	latin1_swedish_ci		No	None		
<input type="checkbox"/>	Password	varchar(7)	latin1_swedish_ci		No	None		
Check All / Uncheck All With selected:								

Figure 31: Structure of User's Table

Once the user has entered the information to register new user, all the information will be saved in the table of the database.

After the data has been keyed in the required fill in the 'add new personnel' interface, the users' table will look like Figure 32.

Show : 30 row(s) starting from record # 0

in horizontal mode and repeat headers after 100 cells

+ Options

	id	name	Password
<input type="checkbox"/>	AC9098	Shahirul Aina Nasir	1423
<input type="checkbox"/>	E8696	Ill Nadiyah	123
<input type="checkbox"/>	E6789	Wan Hazlina Wan Harun	090
<input type="checkbox"/>	E6435	Shafeq Marwan	321
<input type="checkbox"/>	C1909	Sharifudin Sahedan	3131
Check All / Uncheck All With selected:			

Show : 30 row(s) starting from record # 0

in horizontal mode and repeat headers after 100 cells





















Figure 32: User's Table with Data Inserted

4.1.2.2 Drugs

The same steps like creating tables for users' database are applied to create table for drugs database. Under drugs, details listed are the drugs' name, description, expiry date, supplier and location, as shown in Figure 33 and Figure 34. Only drugs listed in the database are allowed to be on the shelf.

Server: localhost Database: drugtrek_db Table: drugtrk "Contain informations for inmate"

☐ Browse
 ☐ Structure
 ☐ SQL
 ☐ Search
 ☐ Insert
 ☐ Export
 ☐ Import
 ☐ Operations
 ☐ Empty
 ☐ Drop

Field	Type	Collation	Attributes	Null	Default	Extra	Action
<input type="checkbox"/> Description	longtext	latin1_swedish_ci		No	None		                   

4.1.3. Range between RFID tag and reader

This test needs to be done to check if any interference happened between each tag and reader that affects the efficiency of the system to send and receive the signal. If interference happened, it can defect the system where maybe the tag cannot send the signal to the reader although it has been triggered when the tag on the drug's container have been moved from their place. The distance range from reader and the tag must also be tested to check for their capabilities of communicating with each other although at a long distance.

In order to ensure that there is communication between the reader and tags, there is software for the RFID called Programming Station to make sure which tags can be read by the reader. Below was the test of making sure there is communication between the reader and tags by using the Programming Station.

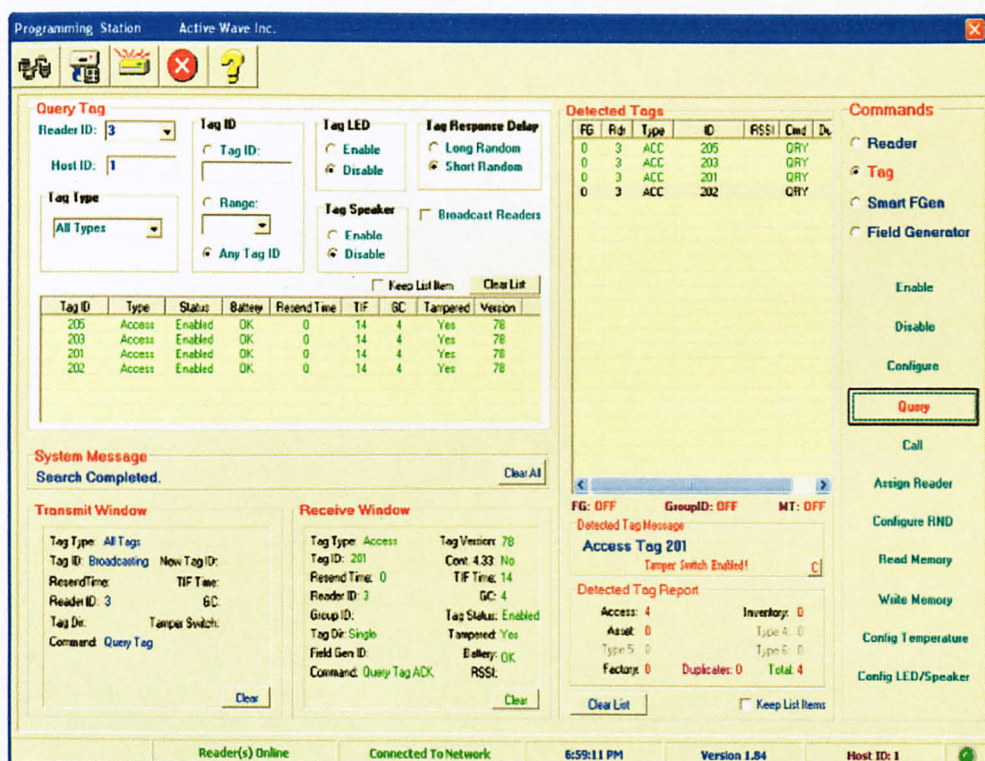







Figure 35: Programming Station Interface

4.1.3.1 Integration between RFID Reader and Tags with Interface

After the RFID reader is successfully communicate with the tag, the connection between the reader and host computer are made to checked there is input signal between reader and the interface. Several testing has been done, and the reader is successfully communicates with the interface build.

This can be shown in Figure 36 where the specified IP address for RFID reader was

being shown in the IP address list box once the  button were clicked. The  icon indicates the network was successfully scanned by the system. In this project, the IP address for the RFID reader is 192.168.2.32. Once user click on the  button, this  icon will appear to indicate the connection between the specified reader and interface is successfully being made.

Once the user click the  button, all the registered tags and its status will appear in the list box on the window.

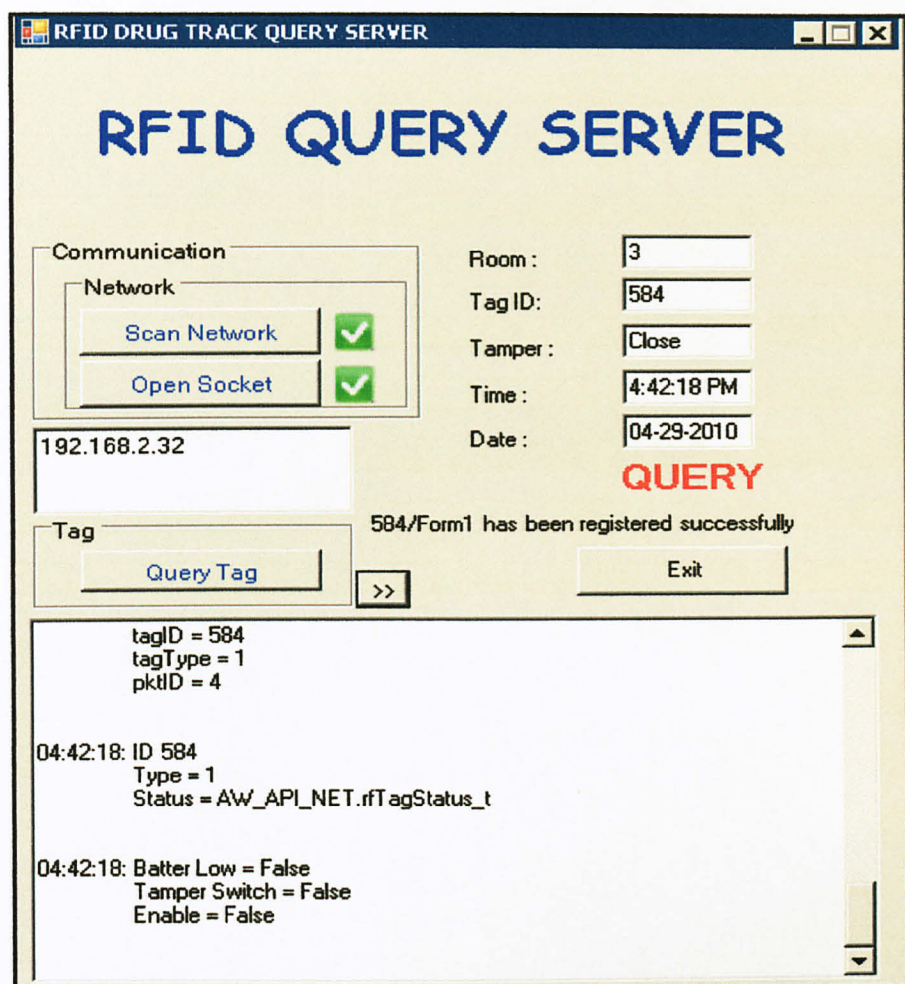


Figure 36: RFID Query Server When It is connected to the System

An alert pop-out window will appear if the tag is out of zone. Below as shown in Figure 37 is the alert prompt window when one of the registered tags are being taken out of zone.



Figure 37: Alert Prompt when registered tag is out of designated zone

The status of the drugs will appear in the box on the User's Main Window as shown in Figure 38.



Figure 38: Status of Drugs on User's Main Window

If the registered drugs were being place back on its place, another pop-out window will appear to indicate that the drug is in the range.

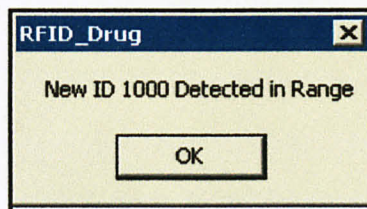


Figure 39: Pop-out Window when Registered Drugs in Zone

4.1.4 Limitation of the Developed System

Upon the completion of this project, several limitations have been recognized. Below is the list of limitations that need to be overcome:

Limitation on the hardware tools:

- Since the RFID kit is being shared with other colleagues, therefore there is decreasing on the reliability of the reader to determine its specified read range.
- The accuracy of read rates on some tags is very low due to battery and several factors that can lead to interference of radio waves between the tags and the reader.
- Each active RFID tags consume much energy from the batteries; therefore shortening the life span of the battery.
- Limitations of the reader to read through variety of substances (*e.g reading through metals*) still exist even though not very influential.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

For this project, we can conclude that this system is essential for tracking drugs/ medicines to pharmacies and clinics which deal with various types of drugs/ medicines. By using this system, movements of drugs can be traced using simple user interface system. The drugs will even be more secured if using this system with the RFID tracking system of the shelf. Plus, this system is suitable for worldwide healthcare used with high drugs/ medicines value.

5.2 Recommendation

There are few of recommendations that can be done to improve this system better. They are as follows;

- Instead of using the RFID reader to read the active tags attached at drugs container inside the whole drugs warehouse, we can specify the reading of RFID reader to a smaller range such as the read range within the drug shelf only.
- The system can also be improved by adding another RFID reader at the entrance of the drugs warehouse to ensure only authorized personnel are allowed to enter the drugs warehouse.
- Utilizing RFID active tag with temperature sensor to continuously monitor drugs temperature.

- The system can also be develop by adding weight scale to measure the drugs container weight for the purpose of checking stock of drugs/ medicine. This can alert the medical staff to call the manufacturer of the drugs and refill when the drugs/ medicine are about to finish.
- Implementation of other RFID technology such as adding alarm to the entrance of drugs warehouse so that the alarm can alert the medical staff about stranger or unregistered staffs are entering the drugs warehouse. This can increase the security system of the drugs/ medicines storage room.

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- [13] *RFID in Healthcare - A panacea for the regulations and issues affecting the industry?* [Online] Sept 8, 2008. [Cited: October 28, 2009.] http://docs.google.com/gview?a=v&q=cache:jPROVZC2e2cJ:www.ups-scs.com/solutions/white_papers/wp_RFID_in_healthcare.pdf+rfid+in+healthcare.html

APPENDICES

APPENDIX A
FYP 1 Gantt Chart

Week No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Semester break
Activities																					
Briefing Session										M											
Technical Writing Workshop										I								E			
IRC Workshop										D								X			
Lab Briefing Session																		A			
Journals										S								M			
Progress Report										E								I			
HSE Talk										M								N			
Referencing										E								A			
Interim Report										S								T			
Oral Presentation										T								I			
Initiative										E								O			
Topic and SV Confirmation										R								N			
Topic Understanding																					
Journals										B											
Methodology Understanding										R								W			
Meeting with Post-Grad Stdnt.										E								E			
Progress Report Discussion										A								E			
Software Development										K								K			
Hardware Test Run																					
FYP 2 Forecast																					

FYP 1 Gantt Chart

APPENDIX B
FYP 2 Gantt Chart

Week No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Activities																				
Briefing Session								M												
Seminar I (IEM Talk)								I									E			
Statistical Analysis Talk								D									X			
Progress Report I																	A			
Poster Exhibition								S									M			
Progress Report II								E									I			
Softbound Dissertation Submission								M									N			
Oral Presentation								E									A			
Hardbound Dissertation Submission								S									T			
								T									I			
								E									O			
Initiative								R									N			
Software Development																				
Interface & Database Development																	W			
Progress Report Discussion								B									E			
Integration of RFID and System								R									E			
Poster Preparation								E									K			
Test Run Full System								A												
Dissertation Discussion and Preparation								K												
Oral Slides Preparation & Mock Presentation																				

FYP 2 Gantt Chart

APPENDIX C
Programming Station Interface

Programming Station Configuration

Detected Tag Display Configuration

- ☐ Multi Display Tag Detect in List View
- ☐ Display Duplicate Tag ID with different Field Generator ID
- ☐ Display Duplicate Tag ID with different Group ID

System Host ID Configuration

Old Host ID:

New Host ID:

☒ Accept All Host ID

Tag Temperature Calibration

Temperature Calibration:

☒ Degree C

☐ Degree F

SAVE

 **Close**

Enable Tag

Reader ID:

Host ID:

Tag Response Delay

☐ Long Random

☒ Short Random

Tag LED

☐ Enable

☒ Disable

Tag Speaker

☐ Enable

☒ Disable

Tag ID

☒ Tag ID:

☐ Any Tag ID

Tag Type

☒ Access

☐ Asset

☐ Inventory

☐ Factory

☐ Any Type

Enabled Tags

Type	ID
ACC	101

☐ Keep List Items

Enabled Tag Report

Access: 1 Inventory: 0

Asset: 0 Factory: 0

Total: 1

☐ Broadcast All Readers

Call Tag

Reader ID:

Host ID:

Tag ID

☐ Tag ID:

☒ Any Tag ID

Tag Type

☐ Access

☐ Asset

☐ Inventory

☐ Factory

☒ Any Type

Tag Response Delay

☐ Long Random

☒ Short Random

Tag Speaker

☐ Enable

☒ Disable

Tag LED

☐ Enable

☒ Disable

☐ Broadcast All Readers

APPENDIX D
Visual Basic 2008 Source Code

Main Menu

```
Imports System
Imports System.ComponentModel
Imports System.Threading
Imports System.Windows.Forms
Imports System.Runtime.InteropServices
Imports Microsoft.VisualBasic
Imports AW_API_NET
Imports System.IO
Imports MySql.Data.MySqlClient
```

```
Public Class main
```

```
    Dim Hconn As IntPtr
    Dim readerIP(20) As Byte
    Dim readerPort As UInt16
    Dim commPort As UInt32
    Dim commBaud As UInt32
    Dim myPKTID As Integer
    Dim registered As Boolean
    Dim strhttp As String
```

```
    Dim ipIdx As Integer = 0
    Dim pubReaderID As Integer
    Dim c As Integer
    Dim txtSender As String
```

```
    Dim tagID As ListViewItem
    Private Strt As System.Threading.Thread
    Dim strCn As String = "Database=drugtrek_db;Data
Source=localhost;User Id=root;Password="
    Dim selID As String
```

```
    Private Sub main_Load(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles MyBase.Load
```

```
        lblOpName.Text = officer.ofName
```

```
        readerPort = Convert.ToUInt16(10001)
        commPort = Convert.ToUInt32(1)
        commBaud = Convert.ToUInt32(115200)
```

```
        Call readConfig()
```

```
        registered = False
```

```
        Strt = New System.Threading.Thread(AddressOf Thread1)
        Strt.Start()
```

```
End Sub
```

```

Private Sub InsertRow(ByVal tgid As Integer, ByVal st As
Integer, ByVal rdr As Integer, ByVal tpr As String)

    Dim name As String = ""
    Dim zone As String = ""
    Dim location As String = ""
    Dim rowsAlarm As Integer
    Dim dat As DateTime = Nothing
    Dim id As String = ""

    Dim cn As New MySqlConnection(strCn)
    ' If the connection string is null, use a default.
    'MsgBox("Start")
    'Beep()

    If st = 0 Then

        cn.Open()

        Dim cmdName As New MySqlCommand("SELECT * FROM drugtrk
WHERE tag_id = " & tgid, cn)
        Dim readerInmate As MySqlDataReader
        readerInmate = cmdName.ExecuteReader()
        While readerInmate.Read
            id = readerInmate.Item("id")
            name = readerInmate.Item("name")
            zone = readerInmate.Item("Room")
        End While
        readerInmate.Close()
        cn.Close()

        cn.Open()
        Dim cmdLoc As New MySqlCommand("SELECT RoomNo FROM
readers WHERE ReaderID=" & rdr, cn)
        Dim readerLoc As MySqlDataReader
        readerLoc = cmdLoc.ExecuteReader()
        While readerLoc.Read
            location = readerLoc.GetString(0)
        End While
        readerLoc.Close()
        cn.Close()

        Dim cmdAlarm As New MySqlCommand("SELECT * FROM alarm
WHERE id = '" & id & "'", cn)
        Dim daAlarm As New MySqlDataAdapter
        Dim dsAlarm As New DataSet
    
```

```

Dim dtAlarm As New DataTable

cn.Open()

Try
    daAlarm.SelectCommand = cmdAlarm
    daAlarm.Fill(dsAlarm, "searchresult")
    dtAlarm = dsAlarm.Tables("searchresult")
    rowsAlarm = dtAlarm.Rows.Count()
Catch ex As Exception
    MsgBox("Error: " & ex.Source & ": " & ex.Message,
MsgBoxStyle.OkOnly, "Connection Error !!")
End Try

If ConnectionState.Open Then
    cn.Close()
End If

If tpr = "False" Then

    If rowsAlarm = 0 Then

        If location = zone Then
            cn.Open()
            Dim cmdIns1 As New MySqlCommand("INSERT INTO
alarm (ack, id, Name, Zone, ProgressTime) VALUES ('OK' " & "','" & id
& "','" & name & "','" & location & "','" & Format(DateTime.Now(),
"yyyy-MM-dd hh:mm:ss") & "')", cn)
            cmdIns1.ExecuteNonQuery()
            cn.Close()
        Else
            cn.Open()
            Dim cmdIns1 As New MySqlCommand("INSERT INTO
alarm (ack, id, Name, alertType, Zone, ProgressTime) VALUES ('Alert'
" & "','" & id & "','" & name & "','" & 'OUT OF ZONE', " & location &
"', '" & Format(DateTime.Now(), "yyyy-MM-dd hh:mm:ss") & "')", cn)
            cmdIns1.ExecuteNonQuery()
            cn.Close()
            'MessageBox.Show("Alert!!!! (ID:" +
tgid.ToString + ")" + name + " moved from Zone" + zone.ToString + "
To Zone" + location.ToString)
            MessageBox.Show("Alert!!!! (ID:" +
tgid.ToString + ")" + name + " is out of zone!!")
        End If

    Else

        If location = zone Then
            cn.Open()

```



```

        Dim cmdUpdate2 As New MySqlCommand("UPDATE
alarm SET ack = 'OK', alertType = '', ProgressTime = '' &
Format(DateTime.Now, "yyyy-MM-dd hh:mm:ss") & "", Zone = " &
location & " WHERE id = '' & id & "", cn)
        cmdUpdate2.ExecuteNonQuery()
        If ConnectionState.Open Then
            cn.Close()
        End If
    Else
        cn.Open()
        Dim cmdUpdate2 As New MySqlCommand("UPDATE
alarm SET ack = 'Alert', alertType = 'OUT OF ZONE', ProgressTime =
'' & Format(DateTime.Now, "yyyy-MM-dd hh:mm:ss") & "", Zone = " &
location & " WHERE id = '' & id & "", cn)
        cmdUpdate2.ExecuteNonQuery()
        cn.Close()
        'MessageBox.Show("Alert!!!! (ID:" +
tgid.ToString + ") " + name + " moved from Zone" + zone.ToString + "
To Zone" + location.ToString)
        MessageBox.Show("Alert!!!! (ID:" +
tgid.ToString + ") " + name + " is out of zone!!!")
    End If

End If

ElseIf tpr = "True" Then
    'alert.lblType.Text = "TEMPERED!!!!"
    'alert.txtTime.Text = Format(DateTime.Now, "hh:MM:ss
dd-mm-ss")
    'alert.txtName.Text = name
    'alert.txtLocation.Text = location
    'alert.txtID.Text = id
    If rowsAlarm = 0 Then

        cn.Open()
        Dim cmdIns1 As New MySqlCommand("INSERT INTO
alarm (ack, id, Name, alertType, Zone, ProgressTime) VALUES ('ALERT'
" & ", '' & id & ", '' & name & ", 'TEMPERED', " & location & ", '' &
Format(DateTime.Now(), "yyyy-MM-dd hh:mm:ss") & "")", cn)
        cmdIns1.ExecuteNonQuery()
        cn.Close()

    Else

        cn.Open()
        Dim cmdUpdate2 As New MySqlCommand("UPDATE alarm
SET ack = 'ALERT', alertType = 'TAMPERED', ProgressTime = '' &
Format(DateTime.Now, "yyyy-MM-dd hh:mm:ss") & "", Zone = " &
location & " WHERE id = '' & id & "", cn)
        cmdUpdate2.ExecuteNonQuery()
        cn.Close()

    End If

```

```

        MessageBox.Show("Alert!!!! (Tag ID:" + tgid.ToString
+ ") " + name + " is Tempered")

        End If
    End If
    Strt = New System.Threading.Thread(AddressOf Thread1)
    Strt.Start()

End Sub

Public Function GetStringIP(ByVal ip As Byte()) As String

    Dim p As Integer
    Dim s As String
    Dim ct As Integer

    ct = 0
    p = 0
    s = ""
    While (Convert.ToBoolean((ct <= 3)) AndAlso
Convert.ToBoolean((p < 20)) AndAlso Convert.ToBoolean((ip(p) <> 0)))
        If ip(p) <> 46 Then
            s += Convert.ToString(ip(p) - 48) '- 48
            p += 1
        Else
            ct += 1
            p += 1
            s += "."
        End If
    End While
    Return s
End Function

Private Sub readConfig()
    Try
        ' Create an instance of StreamReader to read from a
file.
        Using sr As StreamReader = New
StreamReader("config.txt")
            Dim line As String
            ' Read and display the lines from the file until the
end
            ' of the file is reached.
            frmConfig.lbIp.Items.Clear()
            line = sr.ReadLine()
            If Mid(line, 1, 3) = "ip:" Then
                frmConfig.lbIp.Items.Add(Mid(line, 4))
            End If
            If Mid(line, 1, 7) = "http://" Then
                strhttp = line
            End If
            'lbIp.Items.Clear()
    
```

```

        While Not line Is Nothing
            line = sr.ReadLine()
            If Mid(line, 1, 3) = "ip:" Then
                frmConfig.lbIp.Items.Add(Mid(line, 4))
            End If
            If Mid(line, 1, 7) = "http://" Then
                strhttp = line
            End If
        End While
        sr.Close()
    End Using
Catch E As Exception
    ' Let the user know what went wrong.
    Console.WriteLine("The file could not be read:")
    Console.WriteLine(E.Message)
End Try

End Sub

Private Sub BtnStart_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles BtnStart.Click

    'analyze()
    checkdata()

    Me.commStatus.BackColor = System.Drawing.Color.Green

    Me.commStatus.Text = "ON"

End Sub
Private Sub checkdata()

    Dim check_id(1000) As String
    Dim check_name(1000) As String
    Dim check_room(1000) As String
    Dim check_date As String
    Dim check_time As String
    Dim check_status As String
    Dim i As Integer = 0
    Dim j As Integer
    Dim cn As New MySqlConnection(strCn)
    Dim cmd As New MySqlCommand("SELECT * FROM drugtrk", cn)
    Dim da As New MySqlDataAdapter(cmd)
    Dim ds As New DataSet()
    Dim myReader As MySqlDataReader

    'Open Drug database
    If cn.State = ConnectionState.Closed Then
        cn.Open()
    End If
    'read druglist database and store to buffer
    myReader = cmd.ExecuteReader()

    While myReader.Read

```



```

        i = i + 1
        check_id(i) = myReader.Item("tag_id").ToString
        check_name(i) = myReader.Item("Drug_name").ToString
        check_room(i) = myReader.Item("room").ToString

    End While

    If cn.State = ConnectionState.Open Then
        cn.Close()
    End If
    ' complete read druglist

    For j = 1 To i

        ' check data in alarm

        Dim cnchk As New MySqlConnection(strCn)
        Dim cmdchk As New MySqlCommand("SELECT * FROM readers",
cnchk)

        Dim dachk As New MySqlDataAdapter(cmdchk)
        Dim dschk As New DataSet()
        Dim myReaderchk As MySqlDataReader
        Dim found As Boolean

        If cnchk.State = ConnectionState.Closed Then
            cnchk.Open()
        End If

        myReaderchk = cmdchk.ExecuteReader()

        While myReaderchk.Read

            'str = myReader.getString(0)

            If check_id(j) =
myReaderchk.Item("ReaderID").ToString Then

                found = True
                Exit While
            Else
                found = False
            End If

        End While

        If found = False Then

            Dim rowscheck As String = 0
            Dim cn2 As New MySqlConnection(strCn)

            Dim cmdCheck As New MySqlCommand("SELECT * FROM
alarm WHERE Alm_TagId = '" & check_id(j) & "'", cn2)

```

```

Dim daCheck As New MySqlDataAdapter(cmdCheck)
Dim dsCheck As New DataSet()
Dim dtCheck As New DataTable

If cn2.State = ConnectionState.Closed Then
    cn2.Open()
End If

Try
    With daCheck
        .SelectCommand = cmdCheck
        .Fill(dsCheck, "searchresult")
    End With
    dtCheck = dsCheck.Tables("searchresult")
    rowscheck = dtCheck.Rows.Count()

    'If unable to connect, show error!
Catch ex As Exception
    MsgBox("Error: " & ex.Source & ": " &
ex.Message, MsgBoxStyle.OkOnly, "Connection Error !!")
End Try

If cn2.State = ConnectionState.Open Then
    cn2.Close()
End If

If rowscheck = 0 Then
    cn2.Open()
    check_status = "Out Range"
    check_date = DateString.ToString
    check_time = TimeString.ToString
    'Check for name and if no existing inmates
available, add them
    Dim cmdIns As New MySqlCommand("INSERT INTO
alarm (Alrm_TagID,
Alrm_Room,Alrm_TagName,Alrm_Status,alarm_Date,Alrm_Time) VALUES ('" &
check_id(j) & "',''" & check_room(j) & "',''" & check_name(j) & "',''"
& check_status & "',''" & check_date & "',''" & check_time & "'')",
cn2)

    cmdIns.ExecuteNonQuery()
    If cn2.State = ConnectionState.Open Then
        cn2.Close()
    End If
    'If registration successful, show ID and name
    'Dim style = MsgBoxStyle.Critical

    MsgBox("!!!! ALARM !!!!!" & vbCrLf & "Tag ID "
& check_id(j) + " Out Of Range Detected", MsgBoxStyle.Critical,
"Alarm")

    ' End If ' if found 2

End If

```

```

        'End While
    If cnchk.State = ConnectionState.Open Then
        cnchk.Close()
    End If

    End If ' if found

Next j
TmrCall.Enabled = True
displaylistview()
removealarm()
clearReader()
End Sub
Public Sub removealarm()
    Dim cnchk As New MySqlConnection(strCn)
    Dim cmdchk As New MySqlCommand("SELECT * FROM readers",
cnchk)

    Dim dachk As New MySqlDataAdapter(cmdchk)
    Dim dschk As New DataSet()
    Dim myReaderchk As MySqlDataReader
    Dim found As Boolean
    Dim rm_id As String

    If cnchk.State = ConnectionState.Closed Then
        cnchk.Open()
    End If

    myReaderchk = cmdchk.ExecuteReader()

    While myReaderchk.Read

        rm_id = myReaderchk.Item("ReaderID").ToString

        '*****
        'Check if not in alarm
        Dim cnchk2 As New MySqlConnection(strCn)
        Dim cmdchk2 As New MySqlCommand("SELECT * FROM alarm",
cnchk2)

        Dim dachk2 As New MySqlDataAdapter(cmdchk)
        Dim dschk2 As New DataSet()
        Dim myReaderchk2 As MySqlDataReader
        Dim found2 As Boolean
        'Dim rm_id As String

        If cnchk2.State = ConnectionState.Closed Then
            cnchk2.Open()
        End If

        myReaderchk2 = cmdchk2.ExecuteReader()

        While myReaderchk2.Read

```



```

Then
    If rm_id = myReaderchk2.Item("Alrm_TagID").ToString
        found2 = True
        Exit While
    Else
        found2 = False
    End If

End While
If cnchk2.State = ConnectionState.Open Then
    cnchk2.Close()
End If

'*****
If found2 = True Then
    '#####
    ' Dim id As String = TextBox1.Text.ToString
    Dim rowsCheck As Integer = 0
    Dim cn As New MySqlConnection(strCn)

    Dim cmdCheck As New MySqlCommand("SELECT FROM alarm
", cn)

    Dim daCheck As New MySqlDataAdapter
    Dim dsCheck As New DataSet
    Dim dtCheck As New DataTable

    If rowsCheck = 0 Then
        'Open connection
        cn.Open()

        'Check for name and if no existing inmates
        available, add them
        Dim cmdIns As New MySqlCommand("DELETE FROM
alarm WHERE Alrm_TagID = '" & rm_id & "'", cn)
        rowsCheck =
cmdIns.ExecuteReader.RecordsAffected()

        MsgBox("New ID " & rm_id & " Detected in Range")
        If ConnectionState.Open Then
            cn.Close()
        End If

        'If registration successful, show ID and name
        'MsgBox(id + "/" + name + " has been registered
successfully")

    Else
        'If already existing officer, show error
        'MsgBox("Error!!! " + id + "is already
registered in the database")
    End If
End If

```

```

        End If

        '#####
    End If

End While
If cnchk.State = ConnectionState.Closed Then
    cnchk.Open()
End If
displaylistview()

End Sub
Private Sub displaylistview()

    Dim i As Integer
    Dim cn As New MySqlConnection(strCn)
    Dim cmd As New MySqlCommand("SELECT * FROM alarm ", cn)
    Dim da As New MySqlDataAdapter(cmd)
    Dim ds As New DataSet()
    Dim myReader As MySqlDataReader

    'Open Drug database
    If cn.State = ConnectionState.Closed Then
        cn.Open()
    End If
    'read druglist database and store to buffer
    ListView1.Items.Clear()

    myReader = cmd.ExecuteReader()

    While myReader.Read
        tagID =
        ListView1.Items.Add(myReader.Item("Alrm_TagID").ToString)
        tagID.SubItems.Add(myReader.Item("Alrm_TagName").ToString)
        tagID.SubItems.Add(myReader.Item("Alrm_Room").ToString)
        tagID.SubItems.Add(myReader.Item("Alrm_Status").ToString)
        tagID.SubItems.Add(myReader.Item("Alrm_Date").ToString)
        tagID.SubItems.Add(myReader.Item("Alrm_Time").ToString)
    End While

    While i <= ListView1.Items.Count - 1
        If i Mod 2 = 0 Then
            ListView1.Items(i).BackColor = Color.Aquamarine
        Else
            ListView1.Items(i).BackColor = Color.White
        End If
        i = i + 1
    End While

End Sub

```

```

Private Sub analyze()

    Dim myidcomp As String
    If Me.InvokeRequired Then
        'Me.Invoke(New MethodInvoker(AddressOf list))
    Else
        'Establish connection
        Dim i As Integer = 0
        Dim No As Integer = 0
        Dim ni As Integer = 0
        Dim str As String = ""

        Dim cn As New MySqlConnection(strCn)
        Dim cmd As New MySqlCommand("SELECT * FROM drugtrk", cn)
        Dim cmd2 As New MySqlCommand("SELECT * FROM readers",

cn)

        Dim da As New MySqlDataAdapter(cmd)
        Dim da2 As New MySqlDataAdapter(cmd2)
        Dim ds As New DataSet()
        Dim ds2 As New DataSet()
        'da.Fill(ds, "drugtrk")
        Dim myReader As MySqlDataReader
        Dim myReader2 As MySqlDataReader

        ListView1.Items.Clear()

        If cn.State = ConnectionState.Closed Then
            cn.Open()
        End If

        'Display raw in listview (attendlist)
        myReader = cmd.ExecuteReader()

        While myReader.Read

            'str = myReader.getString(0)
            No = No + 1
            tagID =
ListView1.Items.Add(myReader.Item("tag_id").ToString)
            'tagID =
ListView1.Items.Add(Format(myReader.Item("tagID"), "000"))

tagID.SubItems.Add(myReader.Item("Drug_name").ToString)
            tagID.SubItems.Add(myReader.Item("Room").ToString)
            tagID.SubItems.Add("Out Range")
            tagID.SubItems.Add(DateString.ToString)
            tagID.SubItems.Add(TimeString.ToString)
            'tagID.SubItems.Add(myReader.getString(3))
            'tagID.SubItems.Add(myReader.Item("Zone").ToString)
        End While

        cmd.Connection.Close()

```



```

Do
    'If ni > ListView1.Items.Count - 1 Then Exit For

    myidcomp = ListView1.Items(ni).Text.ToString()
    'MessageBox.Show(myidcomp)
    If cn.State = ConnectionState.Closed Then
        cn.Open()
    End If
    myReader2 = cmd2.ExecuteReader()
    While myReader2.Read
        If myReader2.Item("ReaderID").ToString() =
myidcomp Then

'MessageBox.Show(myReader2.Item("ReaderID").ToString() + " Out Of
Zone ")

                ListView1.Items(ni).Remove()
                ni = ni - 1
            Else

'MessageBox.Show(myReader2.Item("ReaderID").ToString() + " Out Of
Zone ")

                End If

            End While
        cmd2.Connection.Close()
        If ni >= ListView1.Items.Count - 1 Then Exit Do
        ni = ni + 1
        'End While
    Loop

    cmd2.Connection.Close()
    'coloring background
    While i <= ListView1.Items.Count - 1
        If i Mod 2 = 0 Then
            ListView1.Items(i).BackColor = Color.Aquamarine
        Else
            ListView1.Items(i).BackColor = Color.White
        End If
        i = i + 1
    End While

    End If

    TmrCall.Enabled = True
    clearReader()
    StoreAlarm()
End Sub

```

```

Private Sub StoreAlarm()
    Dim i As Integer = 0
    Dim idchk As String
    Dim tag_id As String
    Dim aroom As String
    Dim tagname As String
    Dim astatus As String
    Dim adate As String
    Dim atime As String
    Dim found As Boolean = False

    For i = 0 To ListView1.Items.Count - 1
        tagID = ListView1.Items(i)
        tag_id = tagID.SubItems(0).Text
        tagname = tagID.SubItems(1).Text
        aroom = tagID.SubItems(2).Text
        astatus = tagID.SubItems(3).Text
        adate = tagID.SubItems(4).Text
        atime = tagID.SubItems(5).Text

        ' check data in alarm

        Dim cnchk As New MySqlConnection(strCn)
        Dim cmdchk As New MySqlCommand("SELECT * FROM alarm",
cnchk)

        Dim dachk As New MySqlDataAdapter(cmdchk)
        Dim dschk As New DataSet()
        Dim myReaderchk As MySqlDataReader

        If cnchk.State = ConnectionState.Closed Then
            cnchk.Open()
        End If

        'Display raw in listview (attendlist)
        myReaderchk = cmdchk.ExecuteReader()

        While myReaderchk.Read

            'str = myReader.getString(0)

            idchk = myReaderchk.Item("Alrm_TagID").ToString
            If tag_id = idchk Then

                found = True
                Exit While
            Else
                found = False
            End If

        End While

    End For
End Sub

```

```
If found = False Then
```

```
Dim rowsCheck As Integer = 0  
Dim ID As String = 0
```

```
Dim cn As New MySqlConnection(strCn)
```

```
Dim cmdCheck As New MySqlCommand("SELECT * FROM  
alarm WHERE Alrm_TagID = '" & tag_id & "'", cn)  
Dim daCheck As New MySqlDataAdapter  
Dim dsCheck As New DataSet  
Dim dtCheck As New DataTable
```

```
cn.Open()
```

```
'Check from table (search)
```

```
Try
```

```
With daCheck
```

```
.SelectCommand = cmdCheck
```

```
.Fill(dsCheck, "searchresult")
```

```
End With
```

```
dtCheck = dsCheck.Tables("searchresult")
```

```
rowsCheck = dtCheck.Rows.Count()
```

```
'If unable to connect, show error!
```

```
Catch ex As Exception
```

```
'MsgBox("Error: " & ex.Source & ": " &
```

```
ex.Message, MsgBoxStyle.OkOnly, "Connection Error !!")
```

```
End Try
```

```
'If already connected, close connection
```

```
If ConnectionState.Open Then
```

```
cn.Close()
```

```
End If
```

```
If rowsCheck = 0 Then
```

```
'Open connection
```

```
cn.Open()
```

```
'Check for name and if no existing inmates  
available, add them
```

```
Dim cmdIns As New MySqlCommand("INSERT INTO  
alarm (Alrm_TagID, Alrm_Room, Alrm_TagName, Alrm_Status) VALUES ('" &  
tag_id & "','" & aroom & "','" & tagname & "','" & astatus & "')",  
cn)
```

```
cmdIns.ExecuteNonQuery()
```



```

        If cn.State = ConnectionState.Open Then
            cn.Close()
        End If

        'If registration successful, show ID and name
        MsgBox(" Alarm .... " + tag_id + " has been
detect out of range")

    Else
        'If already existing officer, show error
        'MsgBox("already registered in the database")

    End If

End If

'End While
If cnchk.State = ConnectionState.Open Then
    cnchk.Close()
End If

Next i

End Sub
Private Sub clearReader()
    ' Dim id As String = TextBox1.Text.ToString
    Dim rowsCheck As Integer = 0
    ' Dim name As String = TextBox2.Text.ToString
    'Dim pswd As String = TextBox3.Text.ToString

    Dim cn As New MySqlConnection(strCn)

    Dim cmdCheck As New MySqlCommand("DELETE FROM readers ", cn)
    Dim daCheck As New MySqlDataAdapter
    Dim dsCheck As New DataSet
    Dim dtCheck As New DataTable

    cn.Open()

    'Check from table (search)
    Try
        With daCheck
            .SelectCommand = cmdCheck
            .Fill(dsCheck, "searchresult")
        End With
        dtCheck = dsCheck.Tables("searchresult")
        rowsCheck = dtCheck.Rows.Count()

        'If unable to connect, show error!
    Catch ex As Exception
        ' MsgBox("Error: " & ex.Source & ": " & ex.Message,
MsgBoxStyle.OkOnly, "Connection Error !!")
    End Catch
End Sub

```

```

End Try

'If already connected, close connection
If ConnectionState.Open Then
    cn.Close()
End If

If rowsCheck = 0 Then
    'Open connection
    cn.Open()

    'Check for name and if no existing inmates available,
add them
    Dim cmdIns As New MySqlCommand("DELETE FROM readers ",
cn)
    rowsCheck = cmdIns.ExecuteReader.RecordsAffected()
    If ConnectionState.Open Then
        cn.Close()
    End If

    'If registration successful, show ID and name
    'MsgBox(id + "/" + name + " has been registered
successfully")

Else
    'If already existing officer, show error
    'MsgBox("Error!!! " + id + "is already registered in the
database")

End If

End Sub

Public Sub alarmcheck(ByVal tagid As String)

    Dim rowsCheck As Integer = 0

    Dim cn As New MySqlConnection(strCn)

    Dim cmdCheck As New MySqlCommand("SELECT * FROM alarm WHERE
id = '" & tagid & "'", cn)
    Dim daCheck As New MySqlDataAdapter
    Dim dsCheck As New DataSet
    Dim dtCheck As New DataTable

    cn.Open()

    'Check from table (search)
    Try
        With daCheck
            .SelectCommand = cmdCheck
            .Fill(dsCheck, "searchresult")

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```

        End With
        dtCheck = dsCheck.Tables("searchresult")
        rowsCheck = dtCheck.Rows.Count()

        'If unable to connect, show error!
Catch ex As Exception
    MsgBox("Error: " & ex.Source & ": " & ex.Message,
MsgBoxStyle.OkOnly, "Connection Error !!")
End Try

        'If already connected, close connection
If ConnectionState.Open Then
    cn.Close()
End If

If rowsCheck = 0 Then
    'Open connection
    cn.Open()

    'Check for name and if no existing inmates available,
add them
    Dim cmdIns As New MySqlCommand("INSERT INTO alarm (id, )
VALUES ('" & tagid & "'", cn)
    cmdIns.ExecuteNonQuery()
    If ConnectionState.Open Then
        cn.Close()
    End If

    'If registration successful, show ID and name
    'MsgBox(id & "/" & name & " has been registered
successfully")

Else
    'If already existing officer, show error
    'MsgBox("Error!!! " & id & "is already registered in the
database")

End If
End Sub

Private Sub TmrCall_Tick(ByVal sender As System.Object, ByVal e
As System.EventArgs) Handles TmrCall.Tick
    BtnStart_Click(sender, e)
End Sub

Private Sub callTagID()

End Sub

Private Sub BtnAddOfficer_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles BtnAddOfficer.Click

```



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        addofficer.Show()
    End Sub

    Private Sub BtnAddInmate_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles BtnAddInmate.Click
        addinm.Show()
    End Sub

    Private Sub BtnLogOut_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles BtnLogOut.Click
        officer.Show()
        Me.Hide()
    End Sub

    Sub Thread1()

    End Sub

    Private Sub BtnConfig_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles BtnConfig.Click
        frmConfig.Show()
    End Sub

    Private Sub ListView1_DoubleClick(ByVal sender As Object, ByVal
e As System.EventArgs) Handles ListView1.DoubleClick
        Dim I As Integer
        Dim Description As String = ""
        Dim Drug_name As String = ""
        Dim room As String = ""
        Dim contact As String = ""
        'Dim bed As String = ""
        Dim tID As String = ""
        Dim EnrDate As String = ""

        For I = 0 To ListView1.SelectedItems.Count - 1
            'MsgBox(ListView1.SelectedItems(I).Text)
            Description = ListView1.SelectedItems(I).Text
        Next

        Dim cn As New MySqlConnection(strCn)
        Dim cmd As New MySqlCommand("SELECT * FROM drugtrk ", cn)
        Dim rdr As MySqlDataReader

        cn.Open()
        rdr = cmd.ExecuteReader
        While rdr.Read
            Drug_name = rdr.Item("Drug_name").ToString
            contact = rdr.Item("contact").ToString
            '    bed = rdr.Item("bed").ToString
            room = rdr.Item("room").ToString
            tID = rdr.Item("tag_id").ToString

```

```

        EnrDate = Format(rdr.Item("exp_date"))
    End While
    cn.Close()
    details.lblName.Text = Name
    details.lblHouse.Text = contact
    details.lblID.Text = Description
    'details.lblBed.Text = bed
    details.lblRoom.Text = room
    details.lblTagID.Text = tID
    'details.lblDate.Text = EnrDate

    details.Tag = details.lblID.Text

    details.Show()
End Sub

Private Sub BtnAlert_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles BtnAlert.Click
    AlertHist.Show()
End Sub

Private Sub BtnInmLst_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles BtnInmLst.Click
    InmateList.Show()
End Sub

Private Sub BtnOpList_Click(ByVal sender As System.Object, ByVal
e As System.EventArgs) Handles BtnOpList.Click
    OfficerList.Show()
End Sub

Private Sub commStatus_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles commStatus.Click

End Sub

Private Sub lbl_Operator_Click(ByVal sender As System.Object,
ByVal e As System.EventArgs) Handles lbl_Operator.Click

End Sub

Private Sub Button1_Click(ByVal sender As System.Object, ByVal e
As System.EventArgs)
    'MessageBox.Show("Alert!!!! (ID:" + tgid.ToString + ")" +
Name + " moved from Zone" + Zone.ToString + " To Zone" +
Location.ToString)
End Sub

Private Sub ListView1_SelectedIndexChanged(ByVal sender As
System.Object, ByVal e As System.EventArgs) Handles
ListView1.SelectedIndexChanged

End Sub
End Class

```